U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

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Reply to Attn. of:

Date: March 21, 1974

To: F142, Director, Honolulu Laboratory

From: Tamio Otsu, Chief, Tuna Assessment and Development Investigations

Subject: Trip Report: Trip to Japan, February 3-26, 1974

My itinerary on this trip to Japan was as follows:

February 3 - 1300, departed Honolulu via PAA 1.

4 - 1650, arrived Tokyo.

5 - In Tokyo. Visited American Embassy, also met with Mr. K. Mimura, Japan Fisheries Agency, and Mr. S. Hikosaka, Sanyo Hydrographic Survey Co. 1450, departed for Shimizu, Shizuoka Prefecture.

6-10 - In Shimizu to attend the Tuna Conference and to meet with the staffs of the Far Seas Fisheries Research Laboratory and the Tokai University College of Marine Science and Technology.

11-12 - Visited Ito Branch of Shizuoka Prefectural Fisheries Experimental Station, and tuna bait cooperatives in Ajiro and Usami, Izu Archipelago, Shizuoka Prefecture.

13 - In Shimizu; met again with staffs of Far Seas Fisheries Research Laboratory and Tokai University.

14 - 0815, departed from Shizuoka RR Station for Shin-Osaka. Took All-Nippon Airlines, flight 181, for Oita Airport, Oita Prefecture. Arrived Oita 1345. Visited with staff of the Oita Prefectural Fisheries Department.

15 - Visited tuna bait area in Tsukumi, Oita Prefecture, and other fisheries offices.

16 - 0808, departed Beppu, Oita Prefecture by train, Nishi-Kyushu for Nagasaki City. Arrived 1350. Visited with officials of Nagasaki Prefectural Fisheries Department.

February 17-19 - Visited tuna bait areas in Segawa; met with officials of bait cooperatives; and visited several fisheries offices in the vicinity of Nagasaki City and Sasebo City.

20 - Met with officials of the Sasebo Office of the Prefectural Fisheries Department. Departed from Nagasaki Prefecture's Omura Airport by All-Nippon Airways, flight 158, for Osaka at 1445. Continued on All-Nippon Airways, flight 34, from Osaka to Tokyo. Arrived Tokyo at 1815.

21-25 - In Tokyo to visit the Federation of Japan Tuna Fisheries Co-operative Associations (Nikkatsuren), the Japan Marine Fishery Resource Research Center (Kaiyo Suisan Shigen Kaihatsu Center), the Fishery Attaché at the American Embassy, the Iwatani Sangyo Company (sales agent for the ROBACK automatic fishing machines), Bumble Bee Seafoods office in Tokyo, Japan Fisheries Agency, and other fishery offices and individuals.

26 - 2230, departed Tokyo via PAA 2.

- 1030, arrived Honolulu.

This trip report is arranged by subject matter. The following subjects are included:

A. Japanese Tuna Conference

B. A Japanese scientist's views regarding the western Pacific skipjack tuna resource

C. Japanese southern water skipjack tuna fishery, July-December 1973.

D. Japanese skipjack tuna and baitfish surveys in tropical areas

E. Purse seining for tunas

F. Aggregating skipjack tuna

G. Tuna baitfish fishery in Japan

H. Baitfish transport

I. ROBACK automatic fishing machines

J. Use of live maaji (Trachurus japonicus, bigeye scad) as longline bait

K. Results of regulation of the southern bluefin tuna fishery

L. Antarctic krill

M. Sardines

N. List of persons contacted during trip

A. JAPANESE TUNA CONFERENCE

The Conference was held in Shimizu City at the Chuo-Kominkan (Civic Center). In attendance were about 200 persons representing the tuna industry (prefectural and national fisheries cooperatives), national and prefectural fisheries agencies, fisheries high schools, and universities. The Inter-American Tropical Tuna Commission was represented by Dr. Patrick Tomlinson who is working in Japan for a year on a cooperative project with scientists of the Far Seas Fisheries Research Laboratory. This year, Pat and I were the only foreigners attending the Conference. Pat spoke on the activities of the IATTC, while I spoke on our project to transport live bait (anchovy) from California to Hawaii to augment the supply of baitfish for the Hawaiian skipjack tuna fishery.

The major problems facing the Japanese tuna industry this year are 1) fuel shortage and refueling problems for high-seas vessels, 2) "floating" yen, 3) increasing operating costs of fishing vessels, and 4) generally declining tuna longline catch rates and increasing competition from Korean and Taiwanese longline vessels. Another serious consideration was the upcoming Law of the Sea Conference and its implications. The mercury-in-tuna problem, not as serious as a few years back, is still a matter of concern and the Tokai Regional Fisheries Research Laboratory in Tokyo has been funded for intensive research on this matter. There was less discussion on the Japanese "skipjack tuna boom" this year but one speaker presented his views on the skipjack tuna resources of the western Pacific and the need for Japan to reexamine her skipjack tuna fishery development policy. This matter is covered in another section (B) of this trip report.

Although official Japanese statistics may contradict my observation, I noticed a dramatic decrease in cigarette smoking in the conference room this year. Last year I commented on the "smoke-filled" atmosphere of the conference room. On the surface, it appears that many people had "kicked" the habit during the year. I, incidentally, continued to pollute the air.

B. A JAPANESE SCIENTIST'S VIEWS REGARDING THE WESTERN PACIFIC SKIPJACK TUNA RESOURCE

Dr. Kohei Kasahara, leader of the skipjack tuna studies at the Tohoku Regional Fisheries Research Laboratory presented a paper at the Tuna Conference expounding his views that the skipjack tuna resource of the western Pacific (Japanese coastal waters as well as the Japanese southern water fishery) is already being fished at close to the maximum level. He stated that the maximum catch, in view of the declining trend in catch rates and increasing trip lengths, should be around 180,000 metric tons of skipjack tuna. He also stated that the maximum fishing effort (no. of days of fishing) should not exceed 110,000 days, and that the present effort is already around 90,000 days. Dr. Kasahara mentioned that the catch of skipjack tuna for the last 2 years has exceeded 200,000 metric tons.

Other scientists mildly disagreed with Dr. Kasahara's statements, although agreeing in general that there should not be any great increase in fishing effort in Japanese coastal waters. As for the southern water fishery, the feeling was that new fishing grounds should be sought, and that the catches can still be increased rather significantly.

Dr. Kasahara made it clear that his estimates were tentative and needed further evaluation, but that the Japanese should reexamine their plans to push skipjack tuna fishery development under the present policy.

C. JAPANESE SOUTHERN WATER SKIPJACK TUNA FISHERY, JULY-DECEMBER 1973 (SEE CHARTS, ALSO).[1]

July

Because albacore fishing continued over a relatively long period extending into the latter part of July, the start of large-scale skipjack tuna fishing in the Mariana area was delayed this year until toward the end of July. Three vessels that had moved south in early July fished between lat. 15°-16°N, long. 145°-146°E and took about 110-150 tons per trip (maximum day's catch of 30-35 tons per vessel), thus showing a good start for the season. More vessels entered the fishery in late July and the fishing grounds spread from waters east of the Marianas to around Minami Tori-shima and Wake Island.

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[1]From preliminary data provided by Dr. K. Kasahara, Tohoku Regional Fisheries Research Laboratory, Shiogama-shi, Miyagi-ken, Japan.

The waters extending from the Marianas to Minami Tori-shima and Wake Island were relatively cool last year (27°-28°C) and fishing was unusually poor. However, the surface temperatures reached 29°-30°C this year, and fishing was quite good.

Near Hahajima in the Bonins, catches of about 30 tons per day per vessel were experienced, and for a brief time there was a concentration of the smaller skipjack tuna vessels from Kochi Prefecture in this area.

About a month earlier than usual, a number of vessels fished in the vicinity of Truk (lat. 7°N, long. 153°E) and catches amounted to about 120 tons per trip (maximum day's catch of about 20 tons).

The sizes of fish taken were as follows:

At lat. 16°N, long. 145°E: 4% above 6 kg, 4% between 4.5 and 5.9 kg, 70% between 2.5 and 4.4 kg, 16% between 1.5 and 2.4 kg, and 5% below 1.4 kg.

At lat. 19°-21°N, long. 150°-154°E: 7.2% above 9 kg, 12.7% between 6.0 and 8.9 kg, 6.6% between 4.5 and 5.9 kg, 62% between 2.5 and 4.4 kg, 11% between 1.5 and 2.4 kg, and 0.5% under 1.4 kg.

In waters near Truk, 25% of the fish were larger than 4.5 kg, 95% between 2.5 and 4.4 kg, and 2.5% were between 1.5 and 2.4 kg.

In July, 14 vessels entered the port of Yaizu to unload 1,088 metric tons of fish from southern waters. There were also 12 vessels returning with 280 tons of fish from the Bonins.

August

In the first half of August the grounds extending from the Marianas to Wake Island remained active. At lat. 20°-22°N, long. 160°-171°E, good fishing took place on large skipjack tuna of 9-13 kg. In the latter half of the month, these grounds gradually weakened and moved southward, and a broad fishing ground developed along lat. 5°-7°N, long. 144°-172°E. In the areas lat. 5°-7°N, long. 150°-153°E and lat. 5°-7°N, long. 169°-172°E, there were a few catches of as much as 40-60 tons per day, and there were several vessels making capacity loads.

A few vessels headed toward the Hawaiian Islands but catches there were very poor this year.

During August, 39 vessels unloaded 2,454 metric tons (including 26.5 tons of small yellowfin and bigeye tunas) of southern water skipjack tuna in Yaizu port. The catch per vessel amounted to 63 metric tons.

September

The fishing grounds in the vicinity of the Marianas were so scattered that virtually all of the vessels shifted to waters south of lat. 10°N. Initially, a fishing ground formed south of Grimes Island at lat. 3°-7°N, long. 143°-146°E. Soon thereafter, vessels were catching 30-50 tons per day at lat. 2°-4°N, long. 154°-158°E, and north of Ponape at lat. 7°-9°N, long. 156°-160°E. By midmonth, many vessels were concentrating in these latter grounds and were making consistently better catches than in recent years.

As for fish sizes, 77% of the catch consisted of 3-4 kg fish and 17% of 4.5-5.0 kg fish. Unlike last year, there were virtually no small fish of 1-2 kg size. There were approximately 40 vessels, mostly from Shizuoka Prefecture, fishing these grounds.

Vessels from Mie Prefecture were fishing waters east of long. 160°E extending into the Marshall Islands. Good fishing which began late in August was continuing, and there were many catches of up to 50-60 tons per day. About 40% of the vessels were realizing capacity loads. Since the fishing grounds were located somewhat to the north at lat. 5°-12°N, the fish taken were relatively larger: 60% of the fish were 3-4.5 kg fish, 27% were 4.5-5.5 kg fish, and 5.6% were 6-7 kg fish. There were an estimated 60-70 vessels fishing in this area.

The waters around the Gilbert Islands, which last year provided good fishing, proved poor this year with only a few scattered schools of fish. This may have been due to water temperatures of 26°-27°C, 2.5°-3.5°C lower than last year.

In September, 61 vessels returned to Yaizu to unload 8,120 tons (including 173 tons of small yellowfin and bigeye tunas) of southern water skipjack tuna. The catch per vessel averaged 133 tons. In addition, eight vessels unloaded 99.8 tons of fish from the Bonin area.

October

Continuing from September, fishing by Shizuoka Prefecture vessels was good at 1) lat. 2°-8°N, long. 150°-160°E, and 2) by Mie Prefecture vessels at lat. 3°-12°N, long. 162°-175°E. At the former ground there was a mixture of good and poor fishing in an east-west direction. The fish sizes were about the same as in September, with 87.8% of the catch consisting of 2.5 kg fish and 8.8% of 4.5 kg fish. The latter ground encompassed a broad area from north to south. North of lat. 8°N most of the fish were larger than 5 kg, while to the south, fish of around 2.5 kg predominated.

In the area from lat. 2°-3°N, long. 153°-154°E to lat. 3°-4°N, long. 165°-167°E, there was a zone of discolored water. Numerous reports of "large, thick schools" were received from the area but apparently these schools responded poorly to chumming. The Gilbert Islands area continued to be bathed by low temperature water (26°-27°C) and fishing remained poor.

In October, 83 vessels unloaded 10,874.8 tons (including 92.3 tons of small yellowfin tuna) of southern water skipjack tuna at Yaizu port. The catch per vessel was 131 tons. This month's landings established a new record for southern water skipjack tuna landings.

November

Other than for a brief period in early November when fishing was rather good in waters west of Truk, fishing conditions were worse than in previous months. After mid-November, considerable fishing took place in waters west of long. 150°E (there were practically no vessels remaining in waters east of long. 160°E) and 130-140 vessels from Mie, Shizuoka, Ibaragi, and Kagoshima Prefectures concentrated in the area lat. 6°N-2°S, long. 142°-149°E. At lat. 1°N-2°S, long. 145°-147°E, some catches of 30-60 tons per day continued for a while, but fishing conditions were extremely variable, and the average day's catch amounted to 6-8 tons.

In equatorial waters (lat. 2°N-2°S, long. 145°-150°E) 7.4% of the fish were larger than 4.5 kg, 85.6% were from 2.5 to 4.4 kg, 6.8% from 1.5 to 2.4 kg, and 0.2% were smaller than 1.4 kg. At lat. 5°-9°N, long. 144°-155°E, 1.4% were larger than 6 kg, 15.3% from 4.5 to 5.9 kg, 75.4% from 2.5 to 4.4 kg, 6.7% from 1.5 to 2.4 kg, and 1.2% were smaller than 1.4 kg.

In November, 82 vessels unloaded 9,650.7 tons (118 tons per vessel) of southern water skipjack tuna in Yaizu port. In addition, two vessels that operated the previous month landed 120.9 tons and seven vessels landed 221.9 tons of skipjack tuna from the Mariana Islands area. There were 14.9 tons of small yellowfin tuna for a grand total of 9,879.2 tons.

December

The fishing ground that developed just to the north of Manus (lat. 1°N-2°S, long. 145°-149°E) in mid-November continued to be quite good, with a maximum day's catch of 50 tons and an average catch of 8-12 tons per day. About 50 vessels from Mie and Shizuoka Prefectures fished this area. In early December, the schools were either 1) seen at the surface as jumpers, 2) associated with birds, or 3) feeding on natural prey. However, towards the end of the month, many schools were also found with floating logs, and there

was an increase of small skipjack tuna (1.5-2.5 kg) as well as small yellowfin and bigeye tunas in the catches.

The fish sizes in early December were: 5.3%, 4.5-5.0 kg; 89.5%, 3.0-3.5 kg; and 5.2%, 1.8-2.2 kg. In late December, when log-associated schools were also encountered, the size composition changed to 5.8%, 4.5-5.0 kg fish; 82.2%, 3.0-3.5 kg fish; and 12%, 1.8-2.2 kg fish.

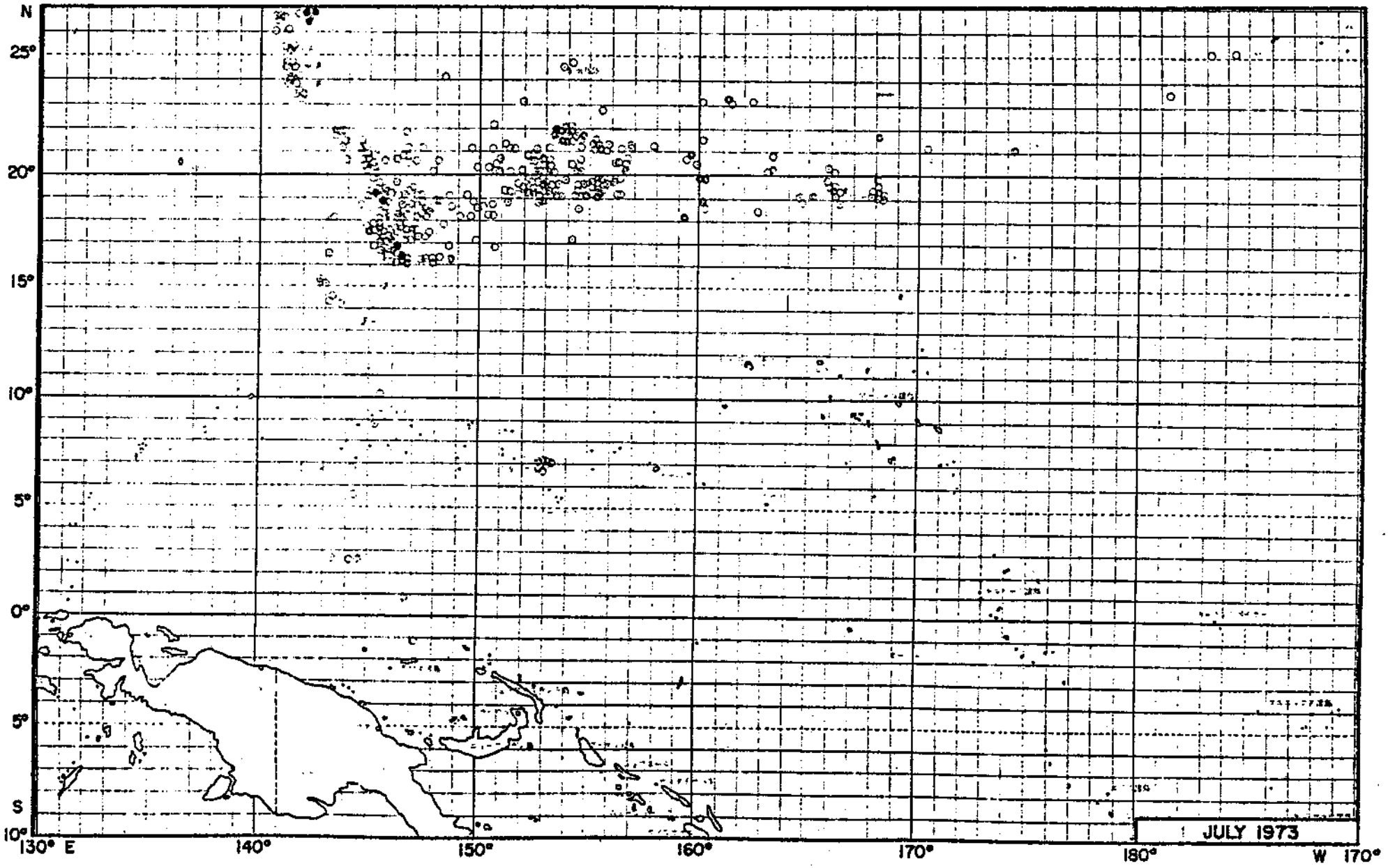
At the same time, moderately good fishing was also seen in waters to the south of the band extending from Palau to Yap, with average catches of 4-5 tons per day.

Also, four or five purse seiners operated in waters around lat. 3°N, long. 134°-136°E, fishing log-associated schools of tuna. They caught 15-50 tons per set of 1.5-4.5 kg skipjack tuna with an admixture of small yellowfin and bigeye tunas.

This season's results of purse seining in the Coral Sea were as follows:

In late October, skipjack tuna was the principal species taken, with catches of 2-20 tons per purse seine set (1.5-5.0 kg skipjack tuna either associated with shark or with floating logs; surface temperature 26.8°-27.4°C). Entering November, the catches of shark-associated yellowfin and bigeye tunas began to increase. The maximum catch per set was 100 tons, and other catches of 10, 27, 40, and 60 tons per set were experienced. This year's fishing season for yellowfin and bigeye tunas extended from November 1 through 12, but since weather conditions did not permit setting the net between November 5 and 11, fishing was possible only on 5 days. Six purse seiners caught an estimated 400 tons of small yellowfin and bigeye tunas during the period. During this season chopped fish were chummed from a boat to aggregate fish before seining. Apparently this method produced some good results.

In December, 99 vessels unloaded 10,556 tons of southern water skipjack tuna in Yaizu port, for a catch per vessel of 106.6 tons. Two purse seiners unloaded an estimated 300 tons of skipjack tuna, and 200 tons of small yellowfin and bigeye tunas.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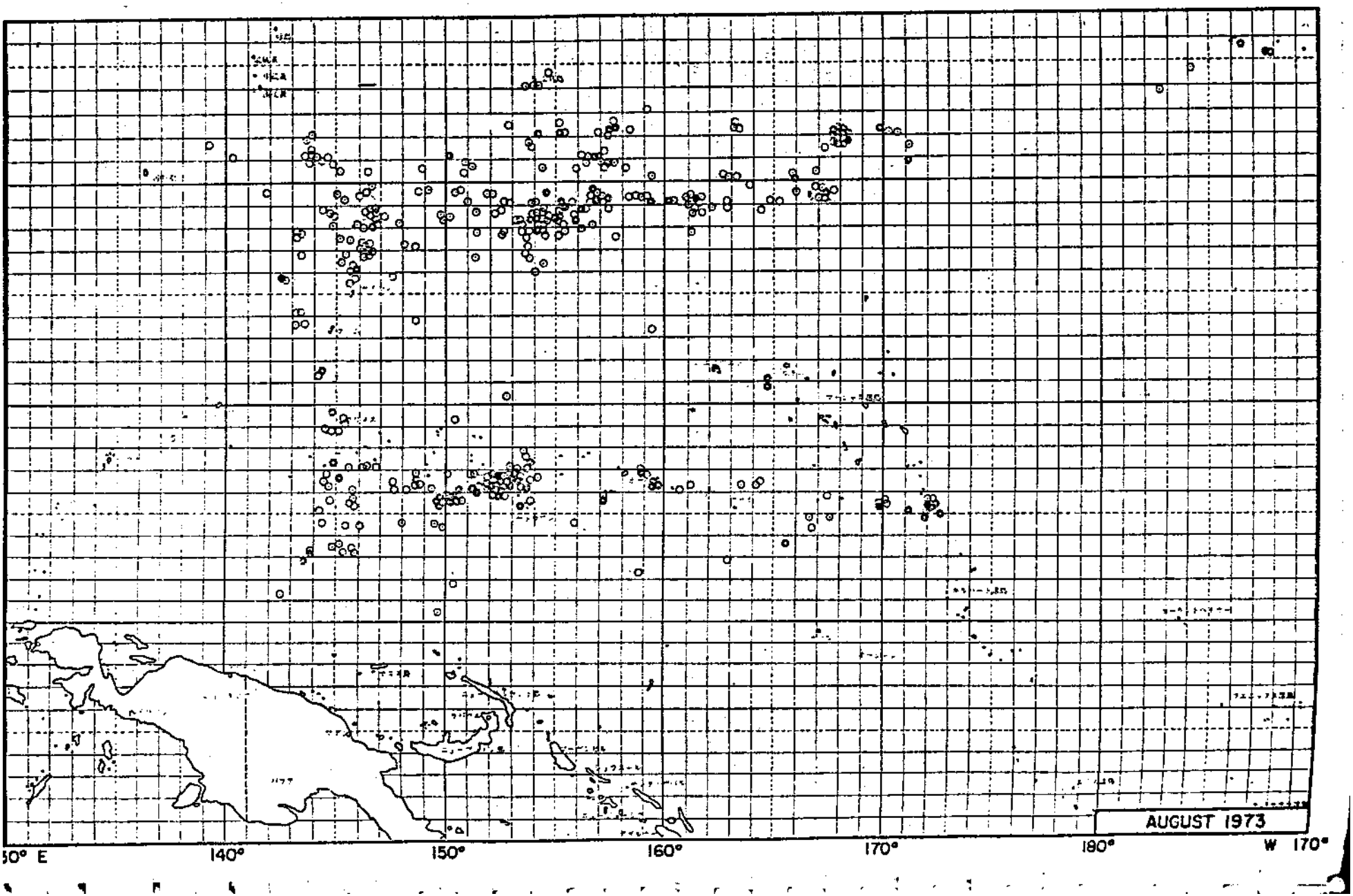
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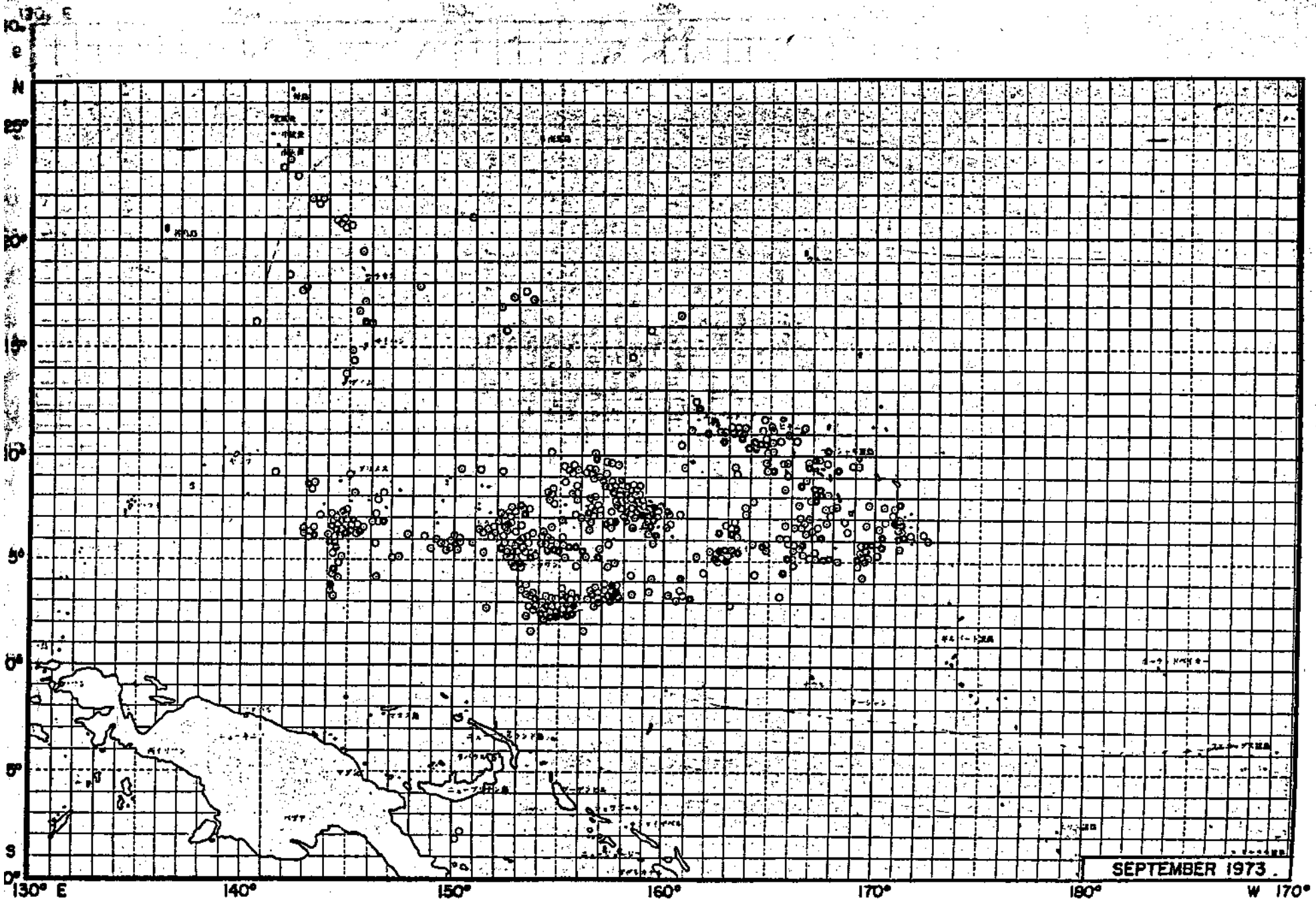
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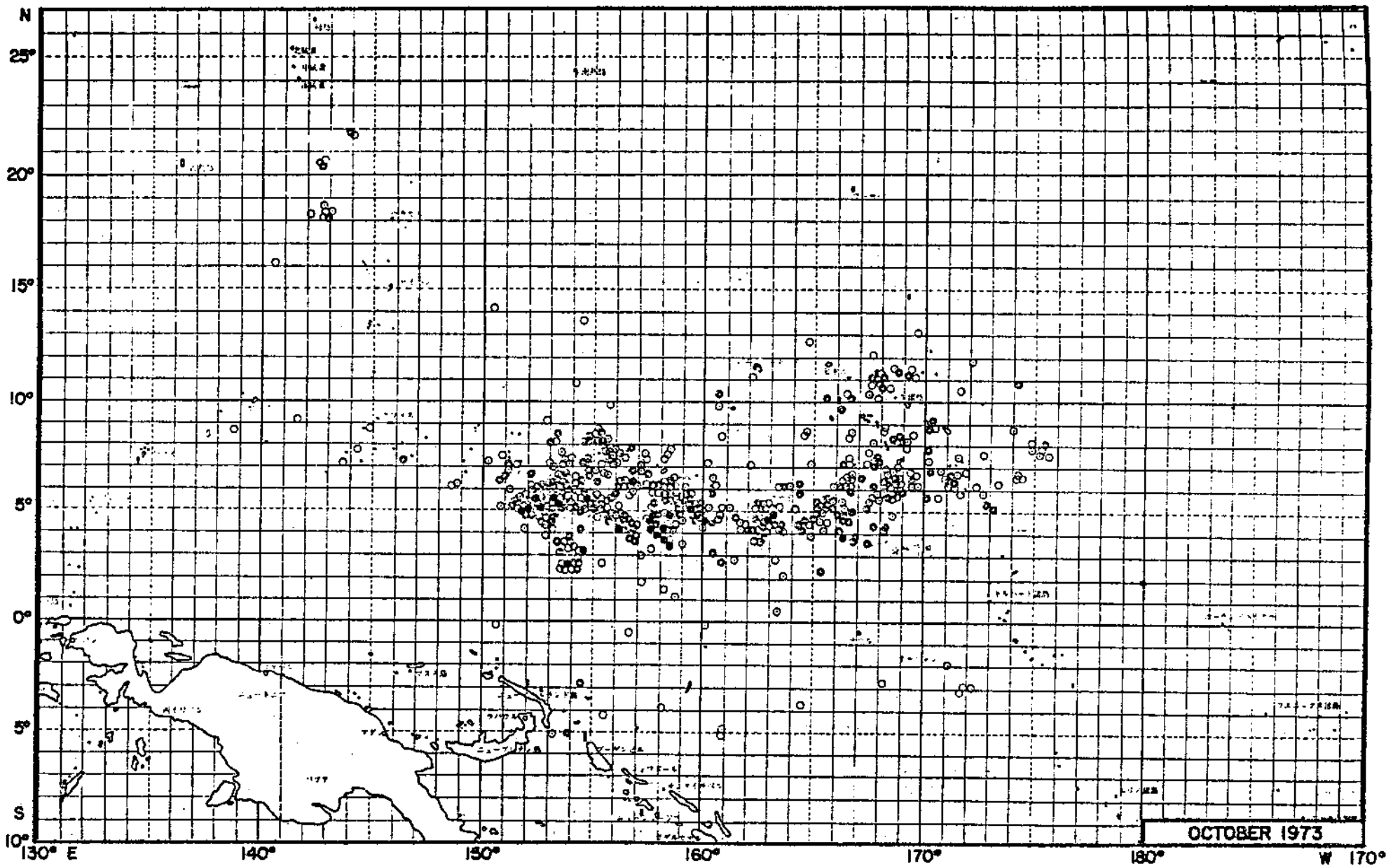
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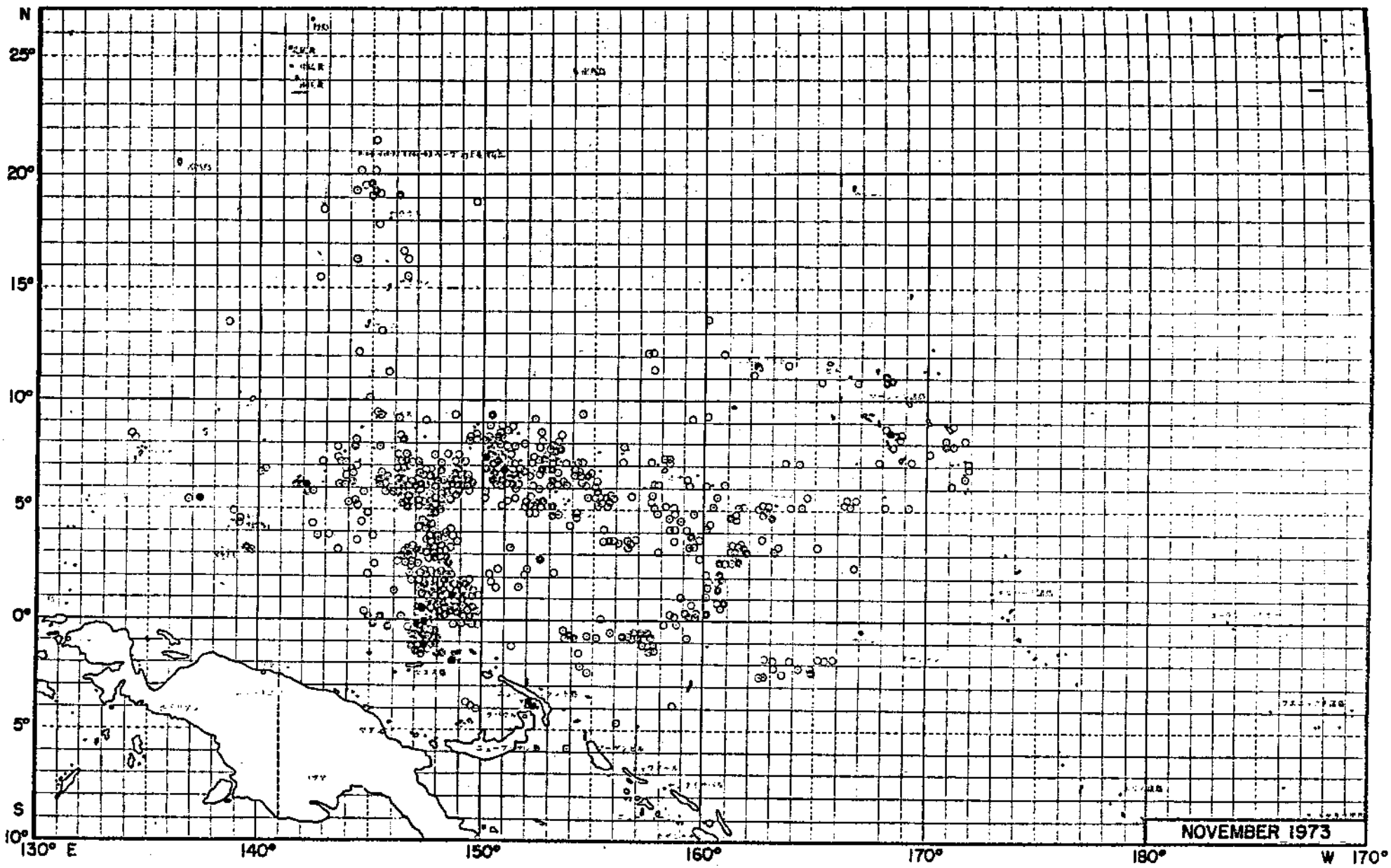
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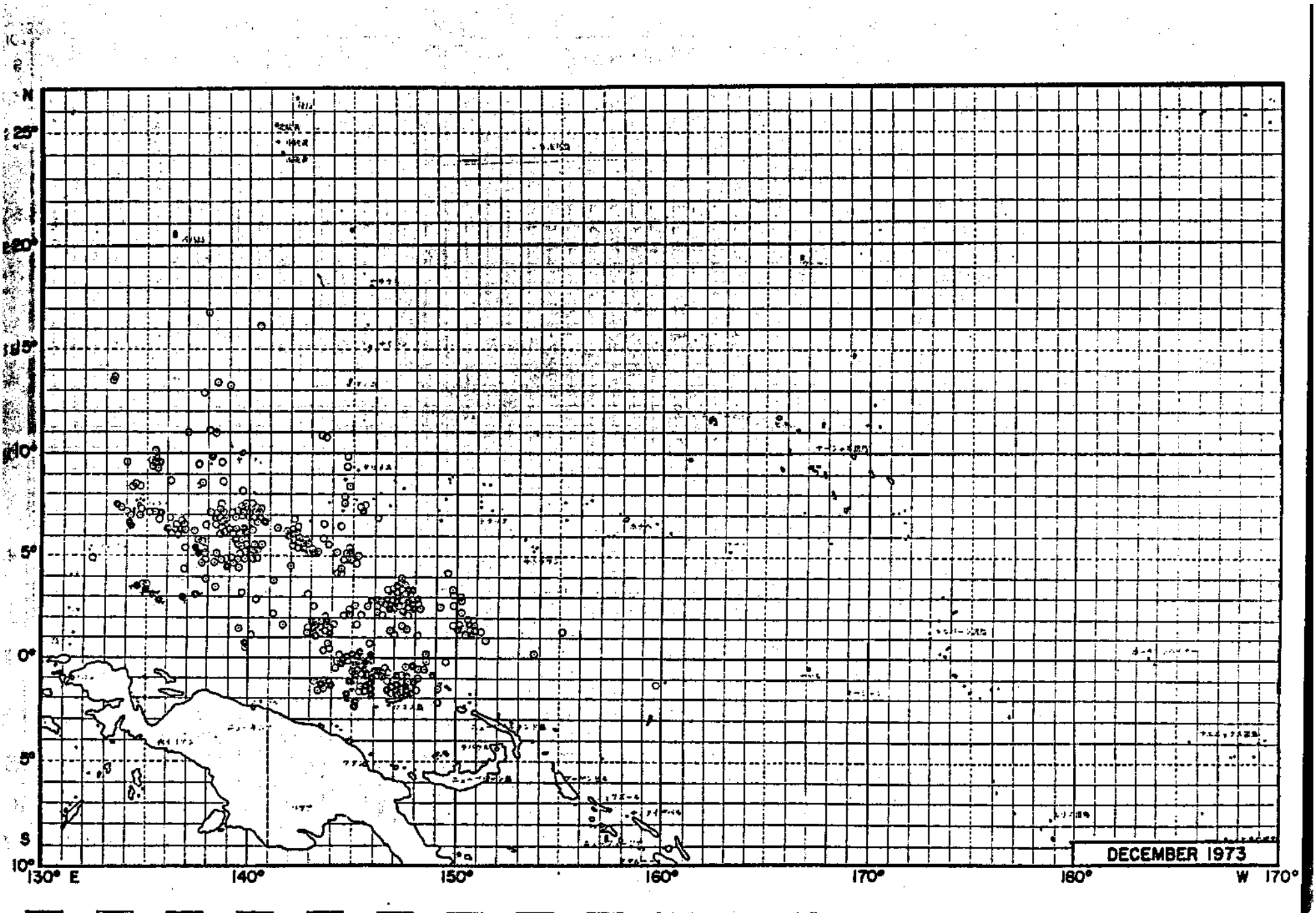
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D. JAPANESE SKIPJACK TUNA AND BAITFISH SURVEYS IN TROPICAL AREAS

Skipjack tuna bait surveys have been conducted by the Japan Marine Fishery Resource Research Center continuously since 1971. In 1973 a 192-ton vessel was chartered to conduct surveys in Tonga, New Caledonia and at Wallis Island (northwest of Samoa).

The bait survey in New Caledonia, using lift nets to capture baitfish at night, resulted in catches of 50-100 buckets a day. Baiting was done in waters 0.5-1.5 mile offshore. Skipjack tuna fishing this year was not as good as last year since, in general, the schools responded poorly to chumming.

At the request of the French, a very brief (1 week) survey was conducted at Wallis Island. This little island has a large lagoon with freshwater runoff from a stream. The surrounding reef makes baiting difficult. Here, only 30-40 buckets of bait were taken, and skipjack tuna fishing resulted in catches of 4-5 tons per day. In general, it was found that skipjack tuna are fairly abundant, but that bait supply is inadequate for any significant fishery development, although further studies are needed.

The series of surveys in Tonga revealed that among the 200-300 islets scattered throughout the archipelago, the northernmost island seems most promising as far as bait is concerned. Surveys were conducted to depths of 30 m. Using beach seines, 20-30 buckets of baitfish were captured in a set. Heavy mortality was encountered in the bait species taken.

The conclusions drawn by the Center are that New Caledonia has definite possibilities for the development of a pole-and-line skipjack tuna fishery. The situation at Wallis Island is not yet clear, but there is little likelihood of the development of a fishery in Tonga. At the present time, Japan is studying the results to see whether or not to propose a joint venture with the Government of New Caledonia.

Center officials indicated that they have now concluded skipjack tuna and live-bait surveys in the Tonga, New Caledonia, and Wallis Island areas, and plan on beginning studies in Micronesia (Truk and Ponape were mentioned as possibilities).

E. PURSE SEINING FOR TUNAS

The Japan Marine Fishery Resource Research Center is continuing to charter purse seiners to conduct fishing experiments in tropical waters. On September 30, 1973 the chartered vessel No. 55 Hakuryu Maru departed Japan to operate in waters between NW Australia and Indonesia (Timor Sea). Purse seining requires relatively calm seas

(wind force of 3 or less). The vessel apparently encountered rough seas during most of the survey period (September-January). Although there were areas of relatively shallow thermocline, inclement weather worked against them. Furthermore, the vessel encountered few drifting logs, and fish schools were very scarce. The results have been most disappointing: as of the end of January only 30 tons of fish had been taken.

In spite of this some Japanese observers feel that purse seining for skipjack tuna is feasible in tropical waters. They believe that the state of the art has reached a point where commercial application can be made. They have been using Japanese-type purse seines (deeper and larger than U.S.-type seines) and feel that by setting around a log-associated school either early in the morning or towards twilight, they can catch a fair amount of fish. (In another part of this report, under Japanese Southern Water Skipjack Tuna Fishery for December 1973, is a report on commercial purse seining results in tropical waters.)

F. AGGREGATING SKIPJACK TUNA

The Far Seas Fisheries Research Laboratory began experimenting with artificial "drift logs" about 2 years ago to see if they could aggregate skipjack tuna. These "logs" are essentially three 2-m square rafts, joined together by ropes 100 m long and set adrift. One raft was strung with palm fronds, and one with 10-m long ropes. One was set adrift with nothing on the bottom.

Most of the experiments to date have been conducted in the vicinity of Papua New Guinea. In the first experiment in 1972, a large school of skipjack tuna about 30 cm long was seen very close to the rafts on the first morning of the drift. However, the school had disappeared by the second morning. Some skipjack tuna were seen jumping during the day and evening about 70 or 80 m from the drifting rafts. The results were inconclusive.

In 1973, a skipjack tuna school was sighted before the rafts were set adrift. However, the school gave no discernible response. No skipjack tuna appeared in the vicinity of the rafts during the first 2 days. A few skipjack tuna schools appeared after the third day, but they continued to move on and in no case did they appear to be attracted to the rafts. After the sixth day of the drift however, a large skipjack tuna school approached the rafts and remained with them. In this 1973 experiment, the fish were near the rafts from about 0600 to around 1300, apparently attracted to them. Unfortunately, it was not possible to continue the experiment.

It was also reported that the No. 55 Hakuryu Maru, the 500-ton purse seine vessel under charter to the Japan Marine Fishery Resource Research Center, had conducted experiments similar to those using rafts to aggregate skipjack tuna for purse seining in the Coral Sea. The vessel reportedly set adrift two 55-gallon oil drums, lashed together and provided with light and radio buoy, and followed them for several days. After 6 days, a school of small yellowfin tuna and some skipjack tuna gathered in the vicinity, and the vessel was able to make a set that resulted in 20 tons of fish. This was the only catch of tunas made by the vessel in the Coral Sea where the sea and weather conditions are generally unfavorable for purse seining. Another report on fish aggregation described an experiment by a Taiyo Fishing Company purse seiner. This vessel set adrift a small boat which had ropes hanging down the sides. The seiner followed the boat for 3 days without seeing any tunas. After 3 days, it lost sight of the boat. The Australian Coast Guard found the boat, identified it, and summoned the purse seiner to Brisbane. The Taiyo Fishing Company decided then and there to discontinue this type of experiment.

In general, the Japanese scientists concluded that it is quite possible to aggregate skipjack tuna by means of drifting devices. Using underwater television, they found that several species of small fish were first attracted to the rafts, and it generally took about a week before skipjack tuna would gather in the vicinity. Skipjack tuna were generally seen from around noon to evening, rarely during the morning hours.

The Honolulu Laboratory is also considering conducting experiments to aggregate skipjack tuna either for purse seining or for pole-and-line fishing.

G. TUNA BAITFISH FISHERY IN JAPAN

According to a report recently published by Mr. Shoichi Masuda, Director, Federation of Japan Tuna Fisheries Co-operative Associations, the total annual catch of anchovy (Engraulis japonica) in Japan is about 230,000-250,000 metric tons, and of this amount, roughly 10% is used as tuna live bait. Japanese statistics show that in 1970, 21,300 metric tons of anchovy were used as live bait, and in 1971, 20,800 metric tons. Anchovy comprises roughly 97% of the total live bait used in Japan. Since the total 1970 tuna catch by the Japanese skipjack tuna fishery amounted to 236,626 metric tons (skipjack tuna and all other species of tuna taken by the live-bait method), the catch of tuna per ton of live bait was roughly 11.1 metric tons.

Table 1 shows some bait data from the Japanese skipjack tuna fishery for 1970. The data give an idea of the live-bait requirements of skipjack tuna vessels of different sizes, and of the value of the fishery that provides live bait to the fishing vessels. It should be noted that all of the conversions of value have been standardized to the present conversion rate of 300 yen per US$1.

One of my missions on this trip to Japan was to visit several of the important tuna baitfish fishery areas. Through the cooperation of the staff of the Far Seas Fisheries Research Laboratory and the Shizuoka Prefectural Fisheries Experimental Station, an itinerary was arranged for me to visit bait fishery areas in Shizuoka Prefecture (Ajiro, Usami), Oita Prefecture (Tsukumi), and in Nagasaki Prefecture (Segawa). These areas are representative of the Kanto and Kyushu baiting areas (central and southwestern Japan, respectively).

In each area visited, the bait receivers (ikesu) were situated in well-sheltered bays with a good circulation of clean "oceanic" water. Fishing for bait was generally done by the bait cooperatives in the various areas. Since there were considerable differences in the mode of operation from place to place, each baiting area will be described separately.

1. Shizuoka Prefecture

In Shizuoka Prefecture, I visited the bait cooperatives in Ajiro and Usami, two of the several important baiting areas in the Prefecture. Shizuoka Prefecture is the leading skipjack tuna fishing prefecture in Japan, and there is considerable demand for live bait. Since the prefectural baiting areas periodically experience bait shortages, about three bait-transport vessels are now in operation transporting bait purchased from Kyushu baiting areas to Shizuoka Prefecture.

Most of the anchovy in Shizuoka Prefecture are being taken by purse seine, either a one-boat or two-boat operation. In addition to the seiners, a baiting unit includes a fish-finder vessel, a small vessel which scouts for anchovy, and a "tugboat" to tow the bait receivers to and from the fishing grounds. The fleet usually leaves for the fishing ground at around 3 p.m. and fishes at night. At the Usami bait cooperative, it was reported that 80-85 men were presently involved in the operation. The officials indicated that they could operate with as few as 60 men but that the cooperative was obligated to keep all of the men employed.

It is essentially a "family" operation, and these people have worked together for many years. The fishing grounds are 3-6 miles from the village, and the fishing area is limited to them by regulations.

Table 1.--Japanese distant-water skipjack tuna fishery data on amount of bait carried per vessel, by vessel size, and amount paid per bucket of bait, shown by quarters of the year and by area of bait purchase, for the year 1970. (Data from Federation of Japan Tuna Fisheries Co-operative Associations.)

Vessel tonnage	Quarter	Bait area								
		Sanriku			Kanto			Shikoku-Kyushu		
		No. of trips	No. of buckets	Price per bucket	No. of trips	No. of buckets	Price per bucket	No. of trips	No. of buckets	Price per bucket
70-135	Jan.-Mar.	--	--	--	9	153	$6.58	4	120	$ 8.64
	Apr.-June	2	97	$10.00	58	207	6.51	1	81	9.01
	July-Sep.	14	114	9.36	34	202	5.71	--	101*	8.75*
	Oct.-Dec.	3	124	9.95	14	206	5.52	--	101*	8.75*
135-165	Jan.-Mar.	--	--	--	1	260	5.50	4	216	5.52
	Apr.-June	--	97*	10.00*	9	297	5.38	2	255	4.71
	July-Sep.	1	103	10.97	9	279	5.50	--	236*	5.07*
	Oct.-Dec.	--	124*	9.95*	4	278	5.47	--	236*	5.07*
165-195	Jan.-Mar.	2	180	8.00	21	313*	5.11*	61	188	7.73
	Apr.-June	1	194	9.33	136	349	5.89	27	190	7.44
	July-Sep.	39	197	9.93	101	364	5.56	11	207	7.05
	Oct.-Dec.	16	177	10.36	28	323	5.80	28	207	8.65
195-225	Jan.-Mar.	--	--	--	--	313	5.11	3	173	8.34
	Apr.-June	--	194*	9.33	9	296	7.11	--	190*	7.44
	July-Sep.	5	171	10.06	6	382	5.63	--	207*	7.05*
	Oct.-Dec.	1	187	9.32	1	325	5.50	1	180	10.00
225-255	Jan.-Mar.	--	--	--	1	478	5.00	38	269	6.64
	Apr.-June	--	194*	9.33*	62	388	6.20	13	223	7.43
	July-Sep.	19	267	9.51	43	417	5.60	1	362	5.52
	Oct.-Dec.	6	232	9.99	7	447	6.19	12	285	7.67
255-285	Jan.-Mar.	--	--	--	1	460	5.50	10	263	6.84
	Apr.-June	--	194*	9.33	17	455	6.87	5	232	6.91
	July-Sep.	2	300	11.00	12	484	5.66	4	256	6.71
	Oct.-Dec.	--	232*	9.99	1	455	5.50	6	203	9.38
>285	Jan.-Mar.	--	--	--	1	475	5.49	8	231	8.18
	Apr.-June	--	194*	9.33	15	496	5.65	3	241	8.34
	July-Sep.	3	274	10.23	12	529	5.51	1	229	7.28
	Oct.-Dec.	1	438	8.50	7	491	5.49	1	212	10.00

Notes: Data above based on records of 58 vessels sampled.

* denotes estimates...no actual data available.

No. of buckets = the number of buckets purchased by a vessel for a single trip.

Price per bucket = amount derived through conversion of 300¥ to US$1.

Sanriku - north of Ibaragi Prefecture; Kanto - between Chiba and Wakayama Prefectures; Shikoku-Kyushu - prefectures in Shikoku and Kyushu Islands.

According to a Mie Prefecture Hamajima Fisheries Experimental Station report, buckets are measured in 14.4-liter buckets but amount of fish varies, e.g., in Kanto area, a bucket is estimated to contain about 3-4 kg of anchovy, and the bait seller determines amount. In the Kyushu and Tohoku areas, a bucket contains 6-7 kg of fish, and the buyer determines amount.

a. Bait receivers (ikesu)

The bait receiver frames are constructed of either bamboo (three pieces lashed together), or of wood (either cypress or cedar). The bamboo or wooden frames are square, hexagonal or octagonal. It is believed that the ideal bait receiver is one that is circular, and the octagonal frame approaches this ideal most closely. The bamboo frames are 6-11 m (20-35 feet) to a side, while the wooden frames are 4.7-6.5 m (15-21 feet). Netting is suspended from the surface frame to form the bait receiver, usually 3.8-5.6 m (12-18 feet) in depth.

Typically, a 4-m (13-foot) square bait receiver, 3.8 m (12 feet) in depth, holds approximately 120 buckets (3-5 kg per bucket) of bait; a 4.7-m (15-foot) square receiver, 3.8 m (12 feet) in depth, holds 200 buckets; a 6.6-m (21-foot) hexagonal bait receiver, 5.6 m (18 feet) deep, holds about 700 buckets of bait. The amount of anchovy held in these receivers also depends greatly on the size of the fish.

The netting of the bait receivers is either anchored to the floor of the bay with a long pole passing through rings at each corner or in some cases, is provided with a ring of lead weights (totaling about 50 kg (110 pounds)) near the bottom of the net.

b. Fishing operation and transfer of bait

When the fish-finder vessel locates a school of anchovy, the school is surrounded with a purse seine (either a one-boat or two-boat operation). The seine is pursed until the fish are concentrated loosely in the bunt of the net. At this point, a portion of the netting from the bait receiver is removed from the frame and placed under the seine; the anchovy are then allowed to swim into the bait receiver. After the fishing operation is completed, a string of receivers is towed back to the bay by the tugboat at a speed of about 1 knot. In Usami, the maximum day's catch by a fishing unit has been 45 receivers of bait. The usual catch is about 10-15 receivers per operation.

c. Bait rearing

The best months for fishing anchovy for live bait is during the winter, from November to January. Anchovy caught in November-December are often reared in the bait receivers until March when they are sold to fishing vessels. The anchovy generally suffer some mortality immediately after

capture. The mortality depends upon temperature of the water, handling, size of fish, etc. Temperature appears to be a very important factor. In summer the catch is generally of small 0-age anchovy and the mortality is very high. Survival may be only 30%-35%, and at best 50%. With lower temperatures, the 1- to 2-year old anchovy taken during the winter months generally do quite well. The survival rate is about 70%.

Mortality is highest during the first 3 days after capture, and the survivors generally do well after that. There are occasional instances in which there is mass mortality from sudden changes in temperature or from the runoff caused by heavy rains. There is also an occasional problem, especially around June, with red tide.

The fish are fed daily on a ration of commercial pellets or minced fish flesh at a rate of about 3% of body weight. The amount of food fed is dependent upon the time of year, with more food given during the warmer months. Officials reported that anchovy can be held in the receivers without feeding for about a week.

2. Oita Prefecture (Tsukumi Bay)

At Oita Prefecture I visited the bait cooperative at Tsukumi. It is one of the important bait areas in Kyushu, and is operated strictly for vessels from outside prefectures since Oita Prefecture does not have a skipjack tuna fishery of its own. Vessels from Shizuoka, Kochi, and Miyazaki Prefectures, among others, come here to purchase their bait.

According to Prefectural officials, about 15,000 tons of anchovy are taken each year, and about 10% is used as live bait. In Tsukumi, the estimated volume of a bucket of bait is 7-10 kg of baitfish. One bucket of bait is sold for 4,000 yen ($13.33).

a. Bait receivers (ikesu)

The common types of bait receivers in use have either bamboo or wooden frames similar to those of Shizuoka Prefecture. The one I visited in Tsukumi was a very large octagonal bait receiver, 8-10 m (26-33 feet) to a side. The depth of the netting was about 10 m (33 feet) and the bait cooperative official reported it to have a volume of up to 1,000 buckets of anchovy (7-10 kg per bucket). Many of the bait receivers were smaller, with much smaller bait-holding capacities.

b. Baiting fleet

A baiting fleet in Tsukumi consists of two 7-ton catcher boats (seiners) or a one-boat seiner, a 2-ton lightboat, a transport, and a tugboat. The fishing is done at night with the lightboat attracting the anchovy. The purse seine is typically about 300 m (960 feet) in length, but varies greatly from fleet to fleet. The fishing method and the method of transferring bait from seine to receiver are similar to methods used in Shizuoka Prefecture.

c. Transferring anchovy from net to receiver

When the seine is pursed to a point where the fish are loosely congregated in the bunt of the net, the float of that portion of the net is lifted over one portion of the bait receiver. That part of the bait receiver is forced downward and submerged to a depth of about 70 cm (28 inches). The anchovy are then allowed to swim into the bait receiver.

Another technique is to remove one portion of the bait-receiver net from the frame, and to place the floats of the bunt portion of the seine over it. The bait-receiver net is then forced downward, allowing the anchovy to swim from the seine into the receiver. Sometimes a light is used to attract the anchovy from the seine into the receiver. When a bait transfer is in progress, there must be absolute quiet on board the vessels so as not to frighten the fish.

d. Bait rearing

A thousand buckets of bait can be caught in one morning in a single set. Baitfish are reared for at least 20 days in winter before they are ready to be sold. The bait cooperatives in every locality stressed the fact that they want to sell only the best bait possible since their business is dependent on their reputation.

More specifically, it was considered here that during the winter when the temperature is low, at least 15-20 days is required for rearing; during the spring and summer, at higher temperatures, a rearing period of at least 10 days is required. Feeding of baitfish generally commences after about a week of rearing. During the winter, the anchovy were fed 1%-2% of body weight; this ratio increased with temperature.

e. Bait mortality

Careful handling is necessary in order to avoid heavy mortality. After capture, it was reported that there is usually about a 25% mortality after the first day, 7% on the second day, and about 1% the third day. Following the third day, there is usually no more than about 1% mortality. This mortality rate generally holds during the winter months. In summer, it is considerably higher.

f. Towing of bait receivers

In towing the bait receivers from the fishing grounds to the rearing area, each of the eight corners of the octagonal bait receivers is provided with a 16 mm chain, weighing about 40 kg each, to keep the net taut. The size and weight of the chain are dependent on the size and dimensions of the bait receivers, and most importantly, on the mesh sizes.

The towing speed depends on current direction, current speed, wind speed, etc. but generally is between 0.5 and 0.8 knots. The towing speed is adjusted so as not to distort the shape of the bait receiver. Here also, the tugboat tows a series of receivers back from the fishing grounds.

g. Fishing period

Most of the fishing for live bait is conducted during winter. On my visit I saw an estimated 1,000 buckets of bait in a single bait receiver. It was 10-12 cm long and in excellent condition. These bait had been caught in December and had already been held for 2 months. This cooperative was expecting to sell this load in March, after 3 months of rearing.

Although anchovy are available throughout the year, most of these bait cooperatives discontinue catching them during the summer months because of the inescapably high mortality. During summer they changed over to rearing such fish as mackerel and bigeye scad.

3. Nagasaki Prefecture (Segawa Bay)

For sometime now I have read and heard about the excellent quality of bait at the Sasebo baiting ground in Kyushu. Some reports indicated that many fishermen considered bait from Sasebo to be of highest quality and that southern water fishing

vessels were partial to the Sasebo bait. In my visit to Nagasaki Prefecture, I learned that the so-called "Sasebo bait" is bait taken in Omura Bay, an enclosed bay located between Nagasaki City and Sasebo City.

In Nagasaki Prefecture the total annual catch of anchovy appears to be around 32,000 metric tons, of which 6%-8% is used as live bait. Most of the live bait is taken from within Omura Bay, while anchovy for processing is taken all along the western coast of Nagasaki Prefecture.

In 1973, about 2,113 metric tons of anchovy were taken in Omura Bay and sold as live bait. Vessels from various prefectures (Shizuoka, Mie, Kagoshima, Kumamoto, etc.) come here to purchase their bait. It was reported by this particular bait cooperative in Segawa that Kumamoto Prefecture regularly sends bait buyers here to purchase up to 60 cages (about 16 metric tons) of anchovy, and rear the bait themselves (in Omura Bay) especially for Kumamoto vessels.

a. Fishing method

In Omura Bay, as in other bait localities, fishing is largely by purse seining, but in addition, about a third of the bait catch is made by beach seining. Bait taken by beach seining is reportedly superior to that taken by purse seining. Beach seining includes a lightboat (with two 500-watt lamps powered from shore), which is anchored in the bay overnight to attract the fish. Early in the morning, at around 4 a.m., the school of fish is surrounded and the beach seine is hauled in by members of the bait cooperative.

Fishing for bait by purse seining is done in the same way as in the other bait localities visited. One big difference is in the use of bamboo cages rather than bait receivers to transport the bait back to the bay from the fishing grounds.

b. Bait receivers (ikesu) and cages (kago)

The bait receivers, which are located in calm waters of the bay, are generally octagonal in shape, 5.8-6.0 m (19-20 feet) to a side. The depth of the netting is about 8 m (25 feet). Many of the bait-receiver frames are constructed of 2-inch steel pipes and buoyed with eight floats. These receivers are set in water about 14-15 m (45 feet) deep. The netting is kept taut with a stone anchor at each corner, the anchor rope passing through loops of the netting

and attached to the bait-receiver frame. Furthermore, the top of the bait receiver is also anchored to shore on one end, and to the sea bottom on the other.

The bait-transport cages (kago) are constructed of woven bamboo strips, and measure approximately 2 x 3 x 3 m (6 x 10 x 10 feet). Each cage holds an estimated 400 kg (880 pounds) of baitfish.

According to an official of the cooperative in Segawa, there is great variability in the amount of baitfish loaded into a cage since this is done by "eyeball estimation." He estimated an average of about 30 buckets of bait per cage (roughly 13 kg per bucket). He added that even the unit of a bucket is extremely variable. For example, when the bait catchers sell their bait to dealers, they may sell about 15 kg of bait per bucket whereas when the bait dealers sell to fishing vessels the bucket may consist of 10 kg or less. One official remarked that the bait sellers purchase the bait from the bait fishermen for about 38,000 yen per cage (or 14 cents per pound).

c. Transfer of bait from purse seine to cages

In Segawa, the purse seining grounds are quite a distance from the bay. It may require up to 5 hours to tow the cages back to the bait receivers. One vessel in the baiting fleet handles the cages, carrying eight cages on its deck out to the fishing grounds, and towing the loaded cages back to the rearing area. When a school of bait is netted and concentrated in the bunt of the net, two men move a cage up to the net and submerge the cage below the surface to a position which will allow the bait to enter. The cages are sufficiently buoyant so that even when loaded with bait, they float to the surface. The loaded cages are towed back slowly and the baitfish are transferred to the bait receivers.

d. Fishing period

While bait-catching by purse seining is conducted only during the winter months (mainly October-December), when bait mortality is the lowest, beach seining is conducted throughout the year. The peak month for beach seining is in January, when as much as 80 cages of bait (about 32,000 kg) can be taken in a set.

e. Rearing of baitfish

About 200-250 buckets of bait are initially transferred to each bait receiver. After the initial mortality, the receivers are topped off with an additional 200-250 buckets of bait. Mortality is high during the first 3 days but levels out after that. The best temperature for rearing bait is about 20°C.

In February, when the temperature is around 7°-8°C, it takes at least 25-30 days of rearing before the bait are in condition to be sold to fishing vessels. At 14°-15°C, the required rearing period is about 13 days, and at 24°-25°C, it takes only about 7 days of rearing. In summer, when the temperature exceeds 30°C, it is not possible to rear baitfish in Omura Bay.

Feeding of baitfish need not begin for 20-25 days in winter, but when the temperature rises to around 20°C, feeding must begin after about a week. Food is generally commercial pellets, but some minced fish flesh is also utilized.

4. General Observations

a. Unit of measurement, the bucket, and selling price

It is obvious that in Japan, as in Hawaii, the unit of bait measurement, the bucket is quite variable. It not only varies from locality to locality, but even within the same locality. In some baiting areas, the bait seller measures the bucket (tends to contain fewer fish), whereas in some areas the buyer does the measuring (tends to be heavier). In general, it is reported that the bucket in the Kanto (central Japan between Chiba and Wakayama Prefectures) baiting areas averages around 3-4 kg of baitfish, whereas the bucket in the Sanriku (north of Ibaragi Prefecture, including the Tohoku area) and the Shikoku-Kyushu areas, is considerably heavier, averaging 6-7 kg or more of baitfish. The price per bucket of baitfish also varies greatly from locality to locality, but in general, it is around 2,900 yen ($9.67) per bucket in the Kanto area and about 3,900 yen ($13.00) in the Kyushu area.

b. Bait sizes

It is generally agreed that the ideal sizes of anchovy for skipjack tuna fishing are fish from 7-12 cm in length (average 10 cm). For albacore fishing, it may be slightly larger ranging up to around 14 cm. Fortunately, the 7-12 cm fish (2-year olds) appear to be quite strong.

c. Bait species

Anchovy makes up about 97% of the live-bait used in Japan. The remainder includes sardines (especially in the past 2 years when sardines began to increase), which in some localities, constitute up to 10% of the bait (mixed in with anchovy).

d. Bait fishing and rearing

It is obvious that successful capture and rearing of baitfish is highly dependent on the temperature of the water. Rearing is most successful during the winter when the temperature is low. Thus, there is very little fishing for bait during the summer months of July-September, when bait mortality is too high for an economical operation. Apparently, 28°C, is a very critical temperature, as above this, the mortality is very high regardless of how carefully the baitfish are handled.

e. Feeding of anchovy in bait receivers

There was some disagreement on just how long anchovy can be held in bait receivers before feeding is started. In Shizuoka and Oita Prefectures, it was reported that feeding should begin after about a week of rearing. On the other hand, in Nagasaki the bait people felt that in winter anchovy can be held for 20-25 days before any feeding is necessary. In any case, it is certain that no feeding is necessary for at least a week. Again, this is closely related to water temperature.

H. BAITFISH TRANSPORT

Because of the periodic bait shortages in Shizuoka Prefecture, a leading skipjack tuna fishing prefecture, three tuna boats have now been modified as bait transports. These vessels go to bait areas in Kyushu (Oita, Nagasaki, etc.) to purchase bait for transport back to Shizuoka to supply their own fishing vessels. The bait-carrying capacities reportedly range from 500 to 1,000 buckets per vessel.

It appears that the turn around time for these transports is about 10 days. Although no one I met was very well informed about this venture, they did indicate that the bait transport was quite successful in that they were experiencing 70%-80% bait survival. However, according to one bait cooperative official, who reportedly saw the condition of bait at the end of the transport, this bait

was arriving in Shizuoka Prefecture in relatively poor condition due to excessive handling. Nevertheless, it appears that bait wil continue to be transported in order to supplement the supply in Shizuoka Prefecture. Most of the transport takes place between September and April.

I. ROBACK AUTOMATIC FISHING MACHINES

Although the ROBACK is but one of several models of automatic skipjack tuna and albacore fishing machines manufactured in Japan, this is probably the only model that has been exported. Presently about 14 units (hydraulic unit plus fishing poles) have been insta led on Australian live-bait vessels. After the introduction of th first demonstration model on an Australian boat, orders for additional units have come in rapidly to the Iwatani Sangyo Company in Tokyo. Company officials said that the most recent order was to airfreight a unit so that the machines could be installed in time for the coming fishing season. The Australians have been enthusiastic about the performance of these machines, as attested to by the press releases. One report was of a 22-ton catch by an Australian vessel with a two-man crew, half of the catch having been mad by two fishing machines.

In Japan, the company has installed about 400 units on Japanese skipjack tuna vessels. In the interest of making more sales in foreign countries, the company is anxious to let us have a demonstration unit for a greatly reduced price. It appears that we may be able to purchase a unit for under $15,000 as compared to the company's listed price of about $25,000 per unit.

J. USE OF LIVE MAAJI (TRACHURUS JAPONICUS, BIGEYE SCAD) AS LONGLINE BAIT

The longline fishermen of Oita Prefecture in Kyushu began experimen ing with live bigeye scad for longline bait beginning around 1966. The tuna longline fishery is based in Tsukumi City, Hoto Island. Presently there are 63 small longline vessels ranging from 19 to 39 gross tons operating out of this base. The fishing grounds extend from Japanese coastal waters to waters off Okinawa, Taiwan, and as far south as the Caroline Islands, as well as in the East China Sea Fishing in coastal waters generally takes place between April and October.

These fishermen have generally relied on frozen squid, saury, and mackerel for longline bait. However, because of the high prices for squid, and the fact that mackerel tended to fall off the hooks much more readily than other bait, the fishermen have come to rely most heavily on saury.

The coastal fishing is principally aimed at taking bluefin tuna. Since the catch rates for bluefin tuna tended to be low, many of the Hoto Island fishermen were lured off the island vessels to join larger, distant-water longliners, and consequently the economy of the islands generally weakened.

Because of these circumstances, studies were begun in 1965 to strengthen the island's longline fishery, including the improvement of fishing gear and longline bait. Some modifications were soon introduced into the gear elements, but perhaps the most radical change came with the introduction of live fish as longline bait. Initially, live mackerel (Pneumatophorus japonicus) was tried and the catch rates for tuna improved by 1.7 times the catch rate obtained with frozen saury. However, the mackerel were relatively large, and only a small volume of fish could be held in the shipboard tank. Furthermore, they were relatively weak and about 60% of the mackerel died before the vessels even reached the fishing grounds. This prompted the trials with bigeye scad. These fish are smaller, and a greater volume could be carried in the tanks. Not only were they able to carry a supply of fish sufficient to last the entire fishing trip, but they found that the survival rate was at least 70%, a vast improvement over mackerel.

The catch rates of tuna using live bigeye scad were found to be 1.5 times better than with mackerel; or 2.6 times better than with frozen saury. The enthusiasm shown by the fishermen for this bait prompted the Oita Prefectural Fisheries Experimental Station to pursue intensive studies on the bigeye scad, particularly in regard to rearing small fish to bait size in fish-rearing enclosures. In 1966 about 40% of the total bait used by these longliners consisted of live bigeye scad, the percentage increased to 60% by 1967, and to 70% by 1970. Presently the use of live bigeye scad is on the order of 60%-70% of the total bait used.

The use of live bigeye scad for bait by the longliners was accompanied by other benefits...it became possible to also rear these fish to marketable size and thus to take advantage of the favorable market prices.

K. RESULTS OF REGULATION OF THE SOUTHERN BLUEFIN TUNA FISHERY

The Japanese, at the recommendation of the Japan Fisheries Agency, and through the cooperation of the Federation of Japan Tuna Fisheries Co-operative Associations, began voluntary regulation of the southern bluefin tuna fishery in 1971. The regulation involved the restriction of fishing in designated areas during specific periods of time. The primary objective was to protect the younger segment of the southern bluefin tuna population from fishing.

In 1972, it was reported that in spite of the regulation, the effective fishing effort for this species had actually increased rather than decreased, as it had been hoped. This was caused by more vessels joining the fleet to fish for the very highly priced sashimi fish. The average weight of the fish taken had decreased and the average age had decreased from 6.3 years in 1965-66 to 5.5 years in 1971-72.

In 1973, 2 years after the voluntary regulation went into effect, the resource level had continued to decline. The scientists at the Far Seas Fisheries Research Laboratory are of the considered opinion that the situation would have been far worse had this regulation not been in effect. However, it is now time to consider enforcing more stringent regulations in order to prevent further a decline in the southern bluefin tuna population. This may involve enlarging the areas of restricted fishing and/or lengthening the periods when no fishing would be allowed. If Korea and Taiwan enter the fishery for this species, it will present another problem. So far there is little indication that this will happen, except for one report of a Korean vessel recently entering Yaizu port to unload southern bluefin tuna.

L. ANTARCTIC KRILL

Last year, in my trip report I stated that the Japan Marine Fishery Resource Research Center had been conducting experiments in the Antarctic with a chartered vessel, the 2,000 ton Chiyoda Maru, and that they were still trying to develop an effective method of catching krill.

During the period October 1973-March 1974, the Center chartered the 1,500-ton No. 11 Daishin Maru, a stern trawler, to continue the survey. The vessel was equipped with a midwater trawl (total length 48.7 m, mouth opening 100 m^2) as well as a "drag purse seine." The latter gear was hardly tested on this cruise. The midwater trawl results were generally excellent. The vessel found that the net can be towed in winds up to force 6-7. The trawl was towed at depths to 70 m but usually at the 15-30 m level. The trawling speed averaged 1.8 knots (1.6-2.0 knots). Most of the tows were for 30-60 minutes over patches of krill at least 150 m long.

The Center personnel feel that they have now perfected the harvesting method for krill. The chartered vessel caught an average of 10 tons per day for a total of 643 metric tons in 63 days of trawling. They reported that more could have been taken but the catch was limited by the processing capacity of the vessel. The maximum catch amounted to 30 tons per day.

Although the Center personnel regarded the No. 11 Daishin Maru (2,000 horsepower engine) too small for krill work, the concensus was that the trawl could still be increased by 50% in size for use by this vessel.

The krill taken were either boiled and frozen or frozen raw for return to Japan. Now that the capture method has been developed to a satisfactory degree, the Center officials believe that the next problem is to work on its utilization. At present, the krill can be boiled and dried for use as soup stock. However, the next move is to try to utilize the krill as a higher-priced ingredient for manufacture of such items as kamaboko and chikuwa (fish cakes). This will require the development of a technique to shell these little creatures. The Center plan is to supply krill samples to various food technology laboratories of commercial food firms to see if new products can be developed. In addition, the plan is to involve various university and government laboratories. For example, it was mentioned that Dr. Shigeno of the Utsunomiya University, who is a specialist on molds, is interested in working on the krill to see if he cannot modify the smell and taste of krill to make it more palatable and suitable for volume consumption. The claim is that krill is too strong in flavor for the Japanese people. Another consideration is to develop an FPC-like (fish protein concentrate) product using krill, but retaining its smell and flavor.

Center officials regard the development of a shelling method a most urgent problem. They proposed that it might be possible to shell krill by chemical means, just as the inner membrane of oranges is removed chemically in the canning process.

Krill fishing is apparently best during the summer months coinciding with their spawning season. January and February are regarded as the best months, but this may be due largely to the fact that weather conditions are best at this time of the year.

M. SARDINES

According to a Japanese press report, the sardines are definitely on a comeback trail in Japan. Catches began to increase in the spring of 1973 and the year's catch amounted to 200,000 metric tons. Good catches are continuing, and the expected 1974 catch is 500,000 metric tons. The increase in sardine landings was reportedly preceded by increases in landings of mackerel as well as saury.

N. LIST OF PERSONS CONTACTED DURING TRIP

Far Seas Fisheries Research Laboratory

Dr. Yoshio Fukuda, Director
Dr. Tadayoshi Ichihara, Chief, Fur Seal Research Section
Dr. Akira Suda, Chief, Research Planning and Liaison Office
Dr. Shoji Ueyanagi, Chief, Division of Pelagic Resources
Dr. Ichiro Yamanaka, Chief, Division of Oceanography
Dr. Sigeiti Hayasi, Division of Pelagic Resources
Mr. Koichi Hisada, do.
Mr. Misao Honma, do.
Dr. Shoji Kikawa, do.
Mr. Susumu Kume, do.
Mr. Yasuo Morita, do.
Mr. Yasuo Nishikawa, do.
Mr. Chiomi Shingu, do.
Mr. Toshio Shiohama, do.
Mr. Jiro Suzuki, do.
Mr. Jiro Morita, Division of Oceanography
Dr. Keiji Nasu, do.
Mr. Hajime Yamanaka, do.
Mr. Mori Yukinawa, do.

Tokai University College of Marine Science and Technology

Dr. Motoo Inoue, Professor
Dr. Mitsuo Iwashita, Professor
Dr. Sigeru Motoda, do.
Dr. Michitaka Uda, do.

Shizuoka Prefectural Fisheries Experimental Station, Yaizu

Mr. Teruo Konagaya, Chief, Fishing Vessel Management Section

Shizuoka Prefectural Fisheries Experimental Station, Ito Branch

Mr. Kiyoshi Tsuge, Branch Laboratory Director
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Mr. Tetsuji Abe
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